REMARKS

This amendment is submitted in an earnest effort to bring this case to issue without delay.

Applicants wish to reiterate their claim to the benefit of their European priority date of 16 April 2002 pursuant to the International Convention. A certified copy of European patent Application 02090144.3 filed 16 April 2002 has been made of record as part of Applicants' PCT/EP03/03860 filed 14 April 2003 of which the instant application is the US national Phase. The Examiner has already acknowledged Applicants' perfected right of priority.

Applicants have canceled claims 1 through 16 and are submitting new claims 17 through 42. Antecedent basis for the new claims may be found in the specification at the bottom of page 7 through page 11, in the drawings, and in original claims 1 through 16, now canceled. Thus claims 17 through 42 are now in the application and are presented for examination.

Applicants have amended page 7 of the specification, lines 19 through 21 to delete any reference to specific claims by number, especially since all original claims now have been canceled.

None of the claims now presented contains any of the improperly alternative expressions, including "for example" and "especially" and so it is believed that all claims now presented are in full compliance with the requirements under 35 USC 112, second paragraph.

Furthermore Applicants believe that no claim now presented should be rejected as obvious under 35 USC 103 in view of the combination of REYNOLDS in view of GROSSE et al; REYNOLDS, GROSSE et al and STICKLER or REYNOLDS, GROSSE et al, and KEILBACH et al.

In spite of the known state of the art (REYNOLDS - US 3 259 52A; GROSSE et al - US 3 137 127 A; STICKLER - US 5 529 648 A KEILBACH - US 3 691 769 A) the person skilled in the art has a number of technical problems if he or she wants to increase the efficiency of the cryogenic solid propellants, to improve the storability and to avoid an expensive management of liquids, and to abolish the requirements of a permanent ignition device - required by other types of cryogenic solid propellants. Such problems are: mechanical properties of frozen fuels that do not satisfy the requirements in the rocket engine, for example adherence to the wall of the engine, stability against accelerating forces and resistance to vibrations;

decrease of the volume of the frozen materials;

changes of the mechanical, physical and chemical properties (brittleness, contraction in volume of the sponge structure) at cooling down to low temperature or changing of pressure;

- thermodynamic phase transformations can lead to unforeseeable changes of properties of the oxidizers (for instance several crystal modifications of frozen oxygen);

filling without bubble formation in the hollow of the sponge when freezing take place;

- pipeless cooling of the oxidizer in the hollow of the sponge.

The complexity of these problems makes it clear that a simple combination of the solutions of the state of the art documents mentioned above does not lead to the invention. REYNOLDS relates to a combustion system that comprises an aluminum sponge having distributed throughout its interior a multiplicity of discrete interconnecting cells. A rod of sponge metal is dipped in liquid oxygen to penetrate into cells. Oxygen condenses at -182.97˚C to an ice blue liquid with a density of 1.118 g/cm^3 and solidifies at -218.4˚C to a hexagonal crystal structure with a density of 1.426 g/cm3. Depending on the temperature, the hexagonal crystal structure turns into rhombohedral 13-oxygen and further into rhombic a-oxygen. The density increases from 1.118 g/cm^{3}to 1.426 g/cm^3 with a significant decreases of volume (see page 4000, Band 5, ROMP CHEMIE LEXIKON, 9. Erweiterte Auflage, Georg Thieme Verlag, Stuttgart, New York, 1992). In a similar way, hydrogen peroxide melts and solidifies at ·I0.43 ˚C, the density increases from 1.45 g/cm^3 to 1.71 g/cm^3 at -20 ˚C and the decrease of volume is approximately 17.9% (see page 5011, Band 6, ROMP CHEMIE LEXIKON, 9. Erweiterte Auflage, Georg Thieme Verlag Stuttgart, New York, 1992). Generally known that all oxidants, which are liquids at temperatures below room temperature, show an

increase of density and a decrease to volume when they finally solidify at very low temperatures.

There is a general danger of shrink hole formation in the pores of sponge material. The propellants loses its homogeneity and combustion properties. This is what the expert expects if he or she uses solidifies cryogenic oxygen or solidified hydrogen peroxide or other solidified.

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Due to the technical difficulties to be expected, the expert will avoid to solidify the liquid oxygen in the pores of the sponge, and will not take GROSSE (see hereinafter) in his or her consideration because a changing of volume of the oxygen takes

place which changes the available surfaces area of the pores in the sponge in unforeseeable way.

The inventive step in comparison with REYNOLDS is created by the fact that the volume decrease at the solidification of the liquid oxygen does not lead to shrink holes in the pores of the sponge.

Further, REYNOLDS does not disclose gaseous oxidizers and their transformation into a solidified phase inside the combustion chamber.

GROSSE described propellant production by freezing, grinding and pressing, or by casting of elements and inserting them into the combustion chamber (see column 5, line 57 to 63). He does not reveal any method that provides filing and freezing inside the combustion chamber. The propellant according GROSSE discloses an internal burner (Fig. 1 and 2) or an end burner (Fig. 3 to 6) which are built up modularly.

The fuel elements are isolated from each other by suitable tin layers (polyethylene, cellophane, papers) or protective sheets or coatings to prevent spontaneous or rapid reaction with the adjacent elements.

Oxidizers and fuel elements in modular propellants rains interact by diffusion driven combustion. Each alternating element in an internal combustion disk stack burns solely because the one above it provides the required reactants downwards. This work for all elements except the uppermost one. Hence, after ignition, this element must be capable of self sustained

combustion. It must be a sustainer using a proper mixture of oxidizer and fuel. The arrangement shown in Fig. 1 lacks depiction of the upper end of the g sin. Without sustainer, it would not burn.

In Applicant's invention it is described that the fuel is ignited by an igniter (see page 9, dine 2 to 4). Further it is clear that the fuel and oxidizer bums during the full time of operation. The propellants according to the invention permit to realize every arbitrary monergole fuel combination.

Moreover, GROSSE does not show a sponge material for storage of a solidified cryogenic oxidant and he uses macroscopic pieces, so called modular elements, of oxidizers and fuel, while in Applicant's invention no such elements are used. Applicants have disclosed a combustible sponge that is filled with liquid oxidizer and then frozen.

Further it is essential in comparison with GROSSE that the sponge of Applicants' invention is bonded on the inner side of the combustion chamber, than filled with liquid oxygen or hydrogen peroxide using capillary forces or pressure gradients within the chars er and to be cooled with a cooling liquid well below the freezing point of either propellant component (see page 8, line 19 to 32, page 9, line 6 to 13 of the German text of the PCT specification).

The frozen modular elements according GROSSE are completely different in comparison with a sponge filled with liquid oxidants. An expert knows the danger of shrink hole formation in

the pores of sponge material when the liquid oxidizer solidifies in the pores. Therefore this state of the art is not relevant.

STICKLER discloses a heterogeneous solid fuel material comprising at least one combustible component defining a continuous solid polymeric matrix substantially free of oxidizer and, dispersed therein, at least one particulate component STICKLER and GROSSE too, does not show a sponge material for storage of a solidified cryogenic oxidizer. Moreover, STICKLER does not describe a frozen liquid within a solid fuel matrix.

In this known state of art the freezing of the liquid dispersion leads to changes of volume in the matrix, too. The propellants loses its homogeneity and combustion properties. This is what the expert expects if he or she uses freezing of liquid dispersions. Also we do not use liquid dispersion.

Due to the technical difficulties to be expected, the expert will avoid to solidify the liquid dispersion, and will not take STICKLER in his or her consideration because a changing of volume of the liquid take place which changes the available surfaces area in the matrix in an unforeseeable way. STICKLER is not relevant.

The propellants according to KEILBACH are liquid slurries - such as liquid oxidizer metal, liquid oxygen and liquid hydrogen. No cryogenic propellants are shown in KEILBACH. This state of the art is not relevant because liquid propellants are used. KEILBACH provides no information to enable those skilled in

the art to deal with the problems associated with cryogenic solid propellants.

In comparison with the state of the art it is new as well as inventive, to fill the pores of the sponge with a liquid or gaseous oxidation phase and transfer the liquid or gaseous phase into a solidified stable phase. When the transformation takes place, the expert expects a decrease of volume of the solidified phase within the pores, a reduction, of homogeneity and a decrease of effectivity, power and economy. The propellants according to the invention shows an increase of the power, an improving of storability and economy. It avoids expensive liquid management and eliminates the necessity of simultaneous permanent ignition in a simple way.

Applicants believe that all claims now presented are allowable over the cited prior art and notice to that effect is earnestly solicited.

Applicants enclose Form PTO 2038 to authorize the US Patent and Trademark Office to charge the cost of the six extra dependent claims to the credit card of the undersigned attorneys.

Respectfully submitted,
Karl F. Ross P.C.

by: Jonathan Myers, 26,963
Attorney for Applicant

er
5 March 2007
5676 Riverdale Avenue Box 900
Bronx, NY 10471-0900
Cust. No.: 535
Tel: (718) 884-6600
Fax: (718) 601-1099

Enclosure: PTO 2038 Charge Form